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ABSTRACT

This volume describes the program plans for the Learning Research and Development Center at the University of Pittsburgh for 1970. The report briefly surveys the long-term objectives of each program and describes in detail the specific plans for accomplishing each project within the programs for the next contract year. (1) The basic learning studies program is to generate and to systematize knowledge about the human learning process. (2) The computer-assisted instruction program is to contribute to individualized education. (3) The educational field studies program is for acquiring knowledge from the study of State schools to develop procedures for adapting education to differing characteristics of students. (4) The individualization of the education program is to develop prototype systems of education which optimize each student's progress. (5) The long-range objective of the changing environments program is to create an experimentally grounded theory of human problem solving and social interaction. (DE)

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PROGRAM PLAN AND BUDGET REQUEST

Volume I

Scope of Work and Projected Activities

Submitted by the

LEARNING RESEARCH AND DEVELOPMENT CENTER
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PREFACE

This document represents one of two volumes prepared for the U.S. Office of Education, representing the Program Plan and Budget Request for the Learning Research and Development Center at the University of Pittsburgh. The Program Plans described in this volume are for the contract year 1970 which begins February 1, 1970 and extends through January 31, 1971. Volume II contains the Budget Request.

The purpose of this report is to provide a brief overview of the long-term objectives of each program and a detailed description of the specific plans for achieving the objectives of each project within those programs for the next contract year. These descriptions followed the Guidelines for the Program Plan and Budget Request which indicated that the Center should assume a stabilized funding level with a "cost of living" increase.

LEARNING RESEARCH AND DEVELOPMENT CENTER

The activities of the Learning Research and Development Center range from basic theoretical research on the learning process through the development of specific procedures, materials, and equipment of instruction to the development of educational programs in school settings for experimentation, tryout, and evaluation. The role of the Center is to provide a functional entity that affords the climate, the organization, and the facilities for maximizing fruitful interaction between relevant academic disciplines and the study of learning and educational practice. This range of activity fosters a constant interplay between instructional implementation and basic experimental work, each providing insights and substance for the other.

The Learning Research and Development Center is now at a turning point in its history. A variety of instructional programs and procedures, which has been under development at the Center, must now be fit into a total educational system. The most striking example of this new coordinated effort involves the Primary Education Project (PEP) for ages three to seven and the Individually Prescribed Instruction Project (IPI) for grades one to six. The initial design of the PEP Project was based, in part, upon the Center's prior experience with IPI. As the two projects began to develop further, new techniques initially attempted in one project were tried out and adapted to the other. PEP has now been added to the IPI experimental school and IPI to the PEP school as the PEP "graduates" move into the early grades. That merging process has suggested further refinements in both projects. In addition, it is now possible to contribute to both in other ways; for example, by applying the computer technology which has been under development both for instructional purposes and for the management of individualized schools; by field testing a series of preschool skills programs which will suggest refinements in the individualized system context in which they are field tested; and by adopting principles developed in the Clarifying Environments Program which could improve the social context in which individualization takes place.

These are just some of the examples of how the Center's original mission of studying the processes of learning and developing new techniques of instruction are about to be realized even more dramaticially over the next few years by integrative efforts which are now possible. It is hoped that what follows will convey some of the excitement now shared by this staff as they begin to see how it is all going to "fit together" into new and better ways of educating American youth.

PROGRAM AND PROJECT REGISTER CODE

Code Number	Title	Principal Investigator
01	Basic Learning Studies Program	R. Glaser
0101	Stimulus Control Project	J. Holland
0103	Learning Strategies Project	R. Glaser
0104	Memory Project	W. Donaldson
0105	Psycholinguistics Project	C. Perfetti
0108	Beginning Reading Project	R. Glaser
0109	Behavioral Analysis of Teaching Project	L. Resnick
0110	Pre-School Skills Project	J. Holland
03	Computer-Assisted Instruction Program	R. Glaser
0301	Curriculum Design Project	R. Glaser
0303	Pedagogical Languages Project	R. Fitzhugh
0304	Engineering Research and Design Project	R. Fitzhugh
0305	Computer Facility Development Project	R. Fitzhugh
04	Educational Field Studies Program	C. M. Lindvall
0402	Measurement and Evaluation Project	C. M. Lindvall
0405	Decisions and Values Project	R. Hummel
05	Individualization of Education Program	J. Bolvin
0501	Individually Prescribed Instruction Project	J. Bolvin
0505	Primary Education Project	L. Resnick
0506	Computer Management Project	W. Cooley
06	Administrative and Management Services Program	J. Yeager
0601	Board of Visitors	J. S. Gow
0602	Management Services	J. Yeager
07	Clarifying Environments Program	O. K. Moore

BASIC LEARNING STUDIES PROGRAM
(01)

The general objective of this program is to generate and to systematize knowledge about the human learning process in order to provide a sound base upon which instructional techniques and educational systems can be built. The program is designed to encourage basic research in psychology, to attend to problems that arise from studies aimed at improving instruction in the schools, and to derive from exploratory research findings clues for guiding field experimentation in new and promising directions. The Basic Learning Studies Program draws its problems from both practical applications in the field and basic laboratory research. Since at the present time, the theoretical and technological relationships between basic science and educational practice are tenuous but under intense development, the long-run objective of this program is the contribution of theory and technology which bridges the gap between scientific knowledge and educational practice.

The projects in the program can be divided into two orientations: those which focus on contributing to particular areas of basic exploratory research in learning and those which focus more upon the development of instructional techniques based upon learning principles. At some times, a project will encompass both orientations. Currently, the exploratory research projects in this program are concerned with attention, learning strategies, memory, and psycholinguistics. The developmental research projects are concerned with behavioral analysis and instructional techniques in the areas of beginning reading, pre-school skills, and the tutorial teaching process. Over time, the projects in this program and details of a particular project change as experiments generate new clues for investigation, as new problems are defined by activities in instructional practice, and as new findings and theories in behavioral science emerge.

The Stimulus Control Project is concerned with analysis of the components of and the variables that influence those behaviors generally defined by the words "attention," "orientation," and "observing responses." Investigation of this kind of behavior involves the general problem of determining how stimulus components come to control the behavior of the learner. Two techniques used in the project to study this process are the analysis of eye movement and the application of "operant" analysis of behavior.

The main concern of the Learning Strategies Project is the analysis of the behavioral sequences by which individuals learn basic tasks such as paired association, discrimination, concepts, and rules. Particularly emphasized in this project is the interaction of individual differences with learning variables. The essential methodology employed is the development of techniques that make individual strategies overt and that optimize performance outcomes for the individual learner.

The Memory Project analyzes the variables that contribute to both short-term and long-term memory. It is particularly concerned with organizational factors that interfere with or enhance the memory process, and its methodology is oriented toward techniques that make apparent how memory decodes and encodes information for storage and retrieval. Theoretical models of the structure and mechanisms of memory guide the investigation of these processes.

The Psycholinguistics Project is directed toward an understanding of the variables that influence how language is processed and how meaningful information is obtained from language inputs. It particularly focuses on the analysis of comprehension and the relationships between language characteristics and retention. Its methodology is directed toward the development of techniques for measuring characteristics of linguistic structures, and of components of comprehension, and around the development of theories of cognitive processes.

The Beginning Reading Project has developed a prototype reading program based upon systematic control of stimulus presentation. Its methodology specifically employs special coding and prompting techniques that regularize the correspondences between phonemes and their graphemic representations.

The Pre-School Skills Project is concerned with the development of learning experiences based upon an analysis of fundamental skills that influence subsequent school performance. The development involves the design of a series of programs based on the strategy of programmed instruction with its cycles of testing, revision, and testing. It is contemplated that the work of this project will be incorporated into the IPI-PEP school environments.

The main concern of the Analysis of Teaching Project is the development of a program for instructing teachers in the components of the individualized tutorial teaching process, including observation, diagnosis, and prescription. The program is based upon a detailed behavioral analysis of the components of the tutorial process, and extensive use is made of video tape presentations.

Stimulus Control Project

(Previously Attention Project)
(0101)

The development of educational technology draws heavily on the store of basic research and, in turn, stimulates new approaches and new insights into the nature of learning. The general area of stimulus control is one clear example of this interchange between the laboratory and the classroom. (1) Much of programming technique involves controlling the student's attention to the appropriate material, so that the student is brought to respond to and learn the important relevant material. (2) Errorless learning, which is so important in the new educational technologies, has stimulated new breakthroughs in research in errorless discrimination learning. These breakthroughs are leading to fundamental changes in our conceptualization of the learning process and, in turn, in the applications in educational technology. (3) Now applied areas for training techniques in the many tasks that involve training a point-to-point association between a stimulus dimension and a response dimension is inspiring basic research on this important but neglected fundamental problem. For example, when a child learns to speak, as in early echoic behavior, small variations in sound patterns generated by the parent must come to evoke appropriate responses of the speech musculature, which, in turn, generate sound patterns which sometimes resemble those of the parent. There is then a discriminative stimulus continuum, a response continuum and a reinforcement or feedback stimulus continuum. Most research in learning investigates the development of an association between a single point on the stimulus and a single point on the response continuum. This omission is a considerable handicap to educational applications since in the development of such continuous repertoires as learning speech, learning reading (grapheme-phoneme correspondence), learning handwriting and drawing from copy, to name but a few, the programmer is left with no information on how many simple point to point associations must be established to provide an acceptable approximation to complete correspondence between stimuli and responses. Does the beginning "singer" who learns to sing two notes automatically become able to generate an intervening note? Likewise the precise relationship with the feedback stimulus dimension raises important research questions. The phenomenon of the continuous repertoires is virtually completely lacking in research and theory. A programmatic set of studies is required. For further description of the concept of continuous repertoires see Skinner (1953) and Holland & Skinner (1961).

Our ongoing work on stimulus control involves all three of these fundamental areas. We have demonstrated the plausibility of "observing behavior" as a basis for visual attention in a monitoring task and that these responses are operants. This observing response model of attention is to be extended to selective attention to separate components of a compound stimulus, attention to components in educational material (such as the preschool programs) and attention in the classroom.

Our errorless discrimination work aims to explore variations in the errorless procedures and different properties of the learned product (e.g., stimulus generalization and transposition). The tasks will extend from the simplest discrimination to the learning of relational concepts by children.

In case of continuous repertoires there is no noteworthy research tradition. It is our aim to determine the important variables in this area and systematically investigate them.

Project Plans

Attention -- Equipment and materials have been prepared to extend the eye movement model of observing behavior as an explanation for selective attention to individual components in discrimination learning. The initial experiments will establish the model. Subjects will learn to respond to one visual pattern and not to another visual pattern using the usual discrimination procedures. The visual patterns will each have two components which are spatially separated. By recording eye movements we can determine which element is attended to during learning and which element shows control during a generalization test under extinction. Special problems of equipment and preparation of stimulus materials have largely been completed and exploratory subjects have been run. It is hoped that the experiments establishing the model will be completed in 1971 and open the way to systematic analysis in subsequent years of this classical enigma in learning theory.

Errorless Discrimination -- The simplest case of relational learning is transposition. A series of manipulations have been performed to investigate the basic variables influencing transposition. The method of training is one variable which has been found to be important. These results, however, need to be extended to more complex cases of relational learning. A study is being implemented to investigate the effects of errorless learning on more complex relational learning tasks. Three groups of subjects will be used. One group will be pigeons, used to maximize control of the situation. The other two groups will be preverbal and verbally fluent children, used to assess how verbalization influences relational learning. The effects of both errorless and traditional teaching methods will also be studied. By going from a simple to a more complex case, a general conceptualization may be formulated; such a conceptualization based on empirical evidence, would be extremely useful in the field of education.

Continuous Repertoires -- A long key for a pigeon box has been developed to measure and, if desired, differentially reinforce responses to different positions on the key. Exploratory work on response variability is underway. A program of research will extend through the next year on the variables involved in associating (or "mapping") point by point correspondence (position of peck on the key). The number of distributions of training points and role of differential response feedback are among the more obvious parameters to be explored.

Learning Strategies Project

(0103)

A basic question in the psychology of learning underlying the educational process concerns the relationship between individual differences and learning variables. This project approaches this question by investigating the different strategies individuals employ in the course of learning; in this context, a learning "strategy" is defined as a systematic way of responding which is identifiable in the response history of the learner. One aspect of the research problem is to identify the systematic nature of these strategies; they may be systematic with respect to the characteristics of the stimulus sequences presented to the learner or with respect to characteristics or properties of the learner's response sequences (alteration, perservation, etc.). The methodological problem is to develop experimental techniques for making overt or apparent the learner's strategy in such terms as the way in which he uses information, the hypotheses he develops about this information to guide his subsequent responding, and in general, the heuristics and algorithms which describe the way in which performance during learning occurs. The experimental aspect of this research is to identify conditions of learning which influence these learning processes, for example, task variables, feedback conditions, pre-experimental setting factors, etc. On the basis of an analysis of learning strategies and the variables that influence them, descriptions and models can be built up describing the processes involved.

The other side of the coin with respect to learning strategies is investigation of how the conditions of learning can be arranged to influence learning strategies; this is the problem of instruction. Once techniques have been developed to probe, analyze, and describe the ways in which individuals go about learning or performing a task, it is then possible to investigate parameters which optimize the probability of learning or retention, ways to shape efficient learning strategies, and the relationship between identified learning strategies and individual differences so that learning can be made adaptive to the individual learner. Four experimental approaches to these problems are employed by the project: (1) the conduct of investigations that are designed to develop and test models of behavioral processes in the context of which differences in learning strategies can be described; (2) investigation of the interactions between individual difference variables, task characteristics, and learning strategies; (3) the conduct of investigations that are designed to optimize conditions in the course of learning; rather than describe learning, these investigations attempt to prescribe learning conditions in order to optimize experimental outcomes; and (4) manipulation of the history of the learner on prerequisite component tasks prior to his entrance into a learning situation, e.g., the influence of attentional variables on discrimination learning (Resnick, O'Malley, & Glaser, in preparation) or the influence of learned discriminations on concept acquisition.

Project Plans

The specific project work along these lines that will receive highest priority during the forthcoming year include the following (the order and specific detail of separate experiments will be determined as results are obtained):

Basic Processes of Concept Learning -- A prevalent methodology in the study of individual differences in learning (Glaser, 1967) has been the conduct of studies relating psychometric measures of individual differences to different learning treatments. The results of this line of research have not been encouraging for a number of reasons. A different tack is taken by this project: Attempts are made to work with and find models of basic learning processes and then to find and investigate differences in learning strategies in terms of parameters of the model which refer to individual or task differences. With this in mind, experimental studies of basic processes in concept learning will be carried out in the following areas:

1. The extent to which learners engage in mediation as differentiated from hypothesis-sampling behavior when solving concept identification problems. Research studies (Erickson, 1969; Kendler & Kendler, 1962) suggest some interesting differences in theoretical accounts of the concept learning process. The differing results of these shift studies appear to be dependent upon the instructions given to the subject; if the subjects are given explicit information about stimulus dimensions and the nature of problem solution, then an hypothesis-sampling model accounts for the experimental results; other, more brief instructions may produce different kinds of behavior during concept learning which can be accounted for by mediation theory. It is of interest to investigate whether hypothesis-sampling behavior is evidenced by younger subjects given more explicit instructions about a concept problem. These results would be relevant to developmental accounts of concept learning and also add information about the way in which younger learners solve these problems.

2. Extensions of current models of concept learning to more complex tasks. Certain current models (e.g., Trabasso & Bower, 1968; Gregg & Simon, 1967; Restle, 1962), account for behavior in simple unidimensional concept problems with binary dimensions. It is possible to mathematically extend these models to situations in which the concept to be learned is more complex. On the basis of recent research (Block, 1969), several processes which could account for unidimensional problems with ternary dimensions are suggested. In particular, it is suggested that concept learning could be divided into two stages: one stage in which the subject samples among the dimensions, and a second stage in which paired-associate learning of the value-response pairs occurs or in which subjects may forget previously learned value-response pairings. Also, a control process is postulated that "switches" the subject between these two stages. It is possible to

formalize these processes in a mathematical model and to derive predictions for various aspects of the data, using a technique presented by Millward (1967). In addition, since these suggested models will contain several parameters, the characteristics of the task which influence these parameters will be varied in order to provide additional information about the validity of the models.

The Optimization of Learning Outcomes -- Practically all studies in the literature on concept learning investigate the effects of different variables on the course of concept acquisition, but do not attempt to "teach" concepts, i. e., provide learning conditions which result in efficient strategies of learning and optimize retention and transfer (Glaser, 1969). An attempt will be made to work out a methodology of "contingent" experimentation in which the conditions presented on a learning trial are a function of the characteristics of previous learning history. The LRDC's on-line computer laboratory is especially useful for this purpose.

1. Transfer studies which investigate optimal ways of learning complex rules. While most learning studies investigate behavior with respect to a single task, it is of special interest in studies of concept learning relevant to instruction to determine the ways in which complex rules are "built up" from less complex rules. Haygood and Bourne (1965), for example, have delineated types of conceptual rules that increase in complexity. In the context of this project, it is of interest to define different sequences of rules which facilitate the transfer of processes postulated to account for simple rule learning. With contingent experimentation, the extent of transfer within a sequence from simple to complex rules can be ascertained and appropriate learning conditions provided to a subject at a particular position in the rule hierarchy. It may also be possible to rearrange a hierarchical rule structure on the basis of the learning strategies employed by the subject. This research has relevance for instructional design particularly

for subject matters such as mathematics where the concept structure is clearly hierarchical (Gagné, 1962; Resnick, 1967).

2. Optimizing concept retention. There is a paucity of experimental literature on concept retention, although this clearly is an important factor in school learning. Typically, the method of overlearning to an arbitrarily defined criterion is relied upon to increase the probability of retention of conceptual rules. [Previous work of the project on the investigation of latency during overlearning may be quite significant in this respect (Judd & Glaser, in preparation). The findings of this work indicate that decreases in latency early in the overlearning period may be predictive of subsequent retention; the fact also that latency tends to reach a stationary asymptote suggests the possibility of employing a less arbitrary criterion for defining the termination of an overlearning period.] Additional variables that influence retention need to be investigated. In the context of learning strategies, variables which influence the sequencing of learning trials are of special interest, e.g., the relative number and spacing of positive and negative instances, and the patterning of feedback information. Pilot experimentation needs to be carried out in order to explore the relative significance of the variables that influence concept retention.

The nature of the memory process in concept learning has recently received a good deal of theoretical interest (e.g., Levine, 1969; Trabasso & Bower, 1968; Erickson, 1968). For example, short- and intermediate-term memory processes influencing concept learning that have been suggested are memory for recently experienced stimulus dimensions, memory for hypotheses recently tried but rejected, or a combination of these. Differences in the operation of these memory processes can well be a function of individual differences. If a subject's concept learning behavior can be described by a model in which a sampling is made from a set of tenable hypotheses, then this set is defined by the extent of memory. If individual differences in such memory processes can be identified, then predictions can be made about learning rate; learning trials could be presented which adjust to the rate by controlling the number of possible alternative solutions on any one trial. The methodological problem is to utilize procedures for probing the extent of memory and to study the effect of memory aids.

Because of the utility of the computer in conducting the kind of contingent experimentation which appears to be useful in experiments that optimize learning outcomes, an additional project is concerned with the methodology of contingent experimentation and the characteristics of experimental design and data analysis procedures that are useful for this purpose.

Learner History with Respect to Preconcept Learning Processes -- In addition to short-term learner history, e.g., previous learning trials, that influence concept learning, an important individual difference influencing learning may reside in the more long-term history. One major influence of this kind can be postulated to be the way in which behavioral components basic to the concept learning process have been previously learned. Components of this kind are attentional factors and discriminations and generalizations which underlie the formation of concept classes.

1. Attentional processes. A model which attempts to account for attentional processes in concept learning assumes that subjects sample among the dimensions of a concept problem and select the dimensions to be tested on the basis of their reinforcement history on the dimensions involved (Trabasso & Bower, 1968). Thus selective attention is a function of the number of previously correct responses accrued to each dimension. If the dimensions to which the subject is attending are monitored so that it is possible to control the reinforcement history of each dimension, it appears possible to investigate the effects of various reinforcement parameters (e.g., runs of correct responses) on attention and subsequent concept learning.

2. Discrimination processes. If discrimination of dimensions is basic to concept learning, then the way in which discriminations are learned should influence the higher order behavior of concept acquisition

(The previous work of the project on errorless discrimination learning was directed along these lines. See, for example, Cohen, Glaser, & Holland, 1968; Siegel & Glaser, in preparation.) Two different kinds of theories have been used to explain early stages of discrimination learning (Tighe & Tighe, 1966). One of these is mediational theory and the other differentiation theory. Mediational theory, on which most work has been done, assumes that a subject can perceive differences in the stimuli presented from the beginning of training, and mediation via verbal labels enhances the difference between the stimuli. Differentiation theory holds that the properties of the stimuli are not readily perceived by the subject at the beginning of training, and that the first step in discrimination learning is perceptual learning which leads to an analysis of stimuli properties. Recent studies have tended to emphasize the importance of this perceptual learning as a prerequisite process in discrimination learning in young children. A study is being designed to explore the effect of aiding such perceptual learning in discrimination training; this will be accomplished by requiring appropriate orienting behavior and by the controlled focusing of exploration on the relevant stimuli to be discriminated. Studies are also being designed to explore the effect of different procedures and sequences of discrimination and generalization training prior to concept acquisition.

Memory Project
(0104)

The general problem under investigation is how information is organized in, and utilized by, the memory system. The problem is being attacked by examining the differential effects on the system that accrue from putting information into the system and taking it out. The major objective is to gain a better understanding of the nature of, and interaction between, the three processes of the memory system as conceived by Melton (1963); namely, trace formation, trace storage, and trace utilization. The anticipated output of the project is a series of published papers on theoretical and experimental findings.

Project Plans

During the coming year research activity will focus on the effects of an output, i. e., a test trial, on subsequent performance in the multi-trial free-recall paradigm (Tulving, 1968). Research to date indicates that an output can have large effects on the nature and utilization of stored information (Tulving, 1967; Donaldson, in preparation). An interaction with stage of training is indicated such that at later stages of training an additional output appears to be of more benefit than an additional input whereas early in training an input and output are of about equal importance. Many successive outputs without an intervening input appear to retard performance early in training.

The objective of next year's research is to analyze more precisely the effect of an output. One hypothesis being investigated is that while an input of material plays the major role in the formation and accessibility of higher-order S-units (Tulving, 1962, 1964; Tulving, & Pearlstone, 1966), an output has its beneficial effects on the accessibility of the individual words comprising each higher-order unit.

The basic research strategy of the project involves the manipulation of the number of inputs and outputs the subject receives and the ordering or sequential relationships between inputs and outputs. For example, one of the studies scheduled uses four groups of subjects. Each group of subjects learns a 40-word list and each group has fifty 40-second periods. The difference between the groups is whether the 40-second periods are inputs and outputs. One group, the standard group, will alternate with inputs during periods, 1, 3, 5, 7, ..., 49, and outputs during periods 2, 4, 6, 8, ..., 50. The second group will have inputs only during periods 1, 7, 13, 19, ..., 49 and will output five successive times in the other periods (2, 3, 4, 5, 6; 8, 9, ..., 50). The third group will start out like the standard group, alternating inputs and outputs for the first 24 periods and then switch to five successive outputs after each input for the remainder of the periods. The fourth group will start with five successive outputs and then switch to alternating inputs and outputs at the half-way point. The hypothesis is that by the final stages of practice, the third group will be performing at the highest level and the fourth group will be lowest.

Over the coming year a series of three or four papers should be submitted for publication in the psychological journals.

Psycholinguistics Project

(0105)

The Psycholingustics Project's main objective is basic research into language processing. The ultimate goal and broader context of such research is the increased understanding of human cognitive functioning. The focus of the research will be on the decoding of meaningful information from language input. Linguistically, this entails aspects of syntax and semantics. Psychologically, it means measuring memory and comprehension. And scientifically, it means the possibility of developing and improving theories of cognitive processes as they function in adults and develop in children.

Project Plans

During the next year, the comprehension studies (the developmental study of the role of syntax in understanding) will be continued and modified. Presently we are studying the comprehension of passive sentence structures in young children, with the objective of learning the relative contribution of linguistic structure and memory limitations to comprehension failures observed in four-, five-, and six-year olds. (Secondarily, the experimental situation provides training to the child in interpretation of action-object relations embedded in passive structures.) The main strategy feature of the research is its providing of perceptual processing of linguistic messages, and future plans would extend this method to other aspects of comprehension. Two possibilities being considered here would be the investigation of rule understanding (of the sort involved in concept tasks) and the understanding of language comparators (comparative adjective, for example).

The sentence retention studies will shift emphasis to work on the hypothesis that underlying semantic relationships are extracted from manifest sentence structures and stored in memory. The results of our research on sentence memory indicate that the complexity of a sentence, as given in its manifest structure, is not an important factor in memory (Perfetti, 1969). Thus, it appears increasingly likely that an explanation of sentence retention and comprehension will have to include an account of how underlying relationships are processed.

In the reading studies the objective is to gain knowledge about what is extracted and retained during reading. The present focus is on the retention function of grammatical and semantic information obtained from reading. The method here is to measure recognition memory for entire sentences after intervals varying from immediately after reading up to one week after reading. Based on the notion that what is extracted from written language is a fairly abstract meaning representation, we hypothesize that: (1) The retention loss for grammatical structure is very rapid, unless a structure change signals a meaning change. (2) The retention loss for specific words is related to the amount of meaning change associated with a word change. These hypotheses are consistent with the results of research by Sachs (1967) on memory for spoken discourse.

The project also will be moving into the area of associative processes during the next year. The general problem of interest is the status of implicit verbal associations in language processing. Considerable theoretical importance has been attached to such associations as the psychological definition of meaning (Bousfield, 1961), and it has been found that covert associations must occur as a concomitant to at least some verbal processes (Underwood, 1965). However, it is not known whether implicit associations function as part of everyday verbal processes (i. e., sentence processing). The research, therefore, will deal with the following questions: (1) What interpretation is to be given to the concept of implicit (covert) association? (2) To the extent that such associations regularly occur as part of everyday verbal processes, and to the extent that they can be considered decoding responses, how fully is a word normally decoded? (3) How manipulable are these associations? (4) Are there differences in associative responses (covert) that occur in normal sentence processing as compared with the more contrived single word association test? At present, association norms to ambiguous or homonymic words are being collected (e.g., to ball). These will be used in sentences which manipulate the semantic interpretation of the given words, with the measure of interest being the tendency to falsely recognize certain associates of the word, but not others, as having occurred in spoken or read sentences. A number of such studies would be expected to be done during the next year. (One output of these studies, incidentally, would be the rather unique associative norms for ambiguous words.)

Related to the questions under investigation by the research discussed above is the basic question of what decoding process is involved in responding to meaning carrying elements such as words. One interesting hypothesis is that a word is richly and fully, although unconsciously, encoded (Wickens, 1968). An alternative hypothesis, which we are interested in investigating, is that there is considerable selectivity in what is fully encoded, and that, consequently, what is encoded semantically can be manipulated by verbal context as a function of matching and mismatching certain semantic features. A computer program will be written to assist with these studies, the strategy of which will be to measure word recognition responses, especially recognition failures, as a function of feature context during initial encoding. For example, the recognition memory for the word country would be measured in the presence of the word patriot after having been initially encoded in the presence of the word rural. If recognition memory under such conditions is poorer than under control conditions, this would imply that selected semantic features are involved in processing rather than complete dictionary-type features and also that the orthographic, acoustic, and articulatory features, while undoubtedly encoded, are insufficient retrieval cues.

Work on another aspect of encoding is about to begin and will be ongoing next year as well. This will use as a basic strategy the fact that proactive inhibition (PI) builds up rapidly in the short-term memory experiment but can be released when the meaning features (and other features) of the items are changed (Wickens, 1968). For example, switching from words of positive evaluation to words of negative evaluation released PI. The method allows inferences about what features are encoded, provided other encodable features are carefully controlled for. Studies will be done to test whether grammatical features are encoded when single words are involved (e.g., Does a shift from nouns to verbs release PI?) and whether subjects encode underlying relationships for sentences with similar surface features.

Beginning Reading Project

(0108)

The Beginning Reading program, Stepping Stones to Reading, has been designed to serve as a research vehicle for the identification and study of idiocyncratic learning styles in the acquisition of early reading behaviors. Feedback from placement tests in conjunction with close observation of classroom techniques and procedures are expected to provide substantive data for the individualization of the entire program over the next few years.

Project Plans

Plans for the coming year encompass the conclusion of the first field testing of the revised, multi-tracked program known as Stepping Stones to Reading (formerly known as Beginning Reading Simplified). Five first-grade classrooms will participate in the testing; two classrooms will be located in Pittsburgh and three classrooms will be located in Boston, Massachusetts. Emphasis will be placed on careful monitoring of pupil progress through the program as the first steps are taken for the individualization of the reading system. A trained observor will be placed in the classroom so that precise information can be gathered as to how the teachers utilize the materials and procedures prescribed and the manner in which pupils respond to these same materials and procedures.

A primary goal for individualization is the development of placement tests. These tests will be written to determine the appropriate instructional track for any student at any given point within the program. Students will be placed on tracks determined from an analysis of these test results and careful monitoring of their progress will follow in an attempt to develop valid and reliable instruments for instructional decision making.

A major objective of the study will be to identify for individual children that point at which semantic and syntactic cues become adequate prompts for further learning in the reading process. Experimental tests will be administered within the structure of the reading program in order to determine what performance measures might predict success for a child if he were taken out of the color-coded phonic structure and given material which was not color-coded; it is hoped that predictions can also be made about his relative success with text lacking all phonic control except semantic and syntactic cues.

A teacher's manual will be written which will contain a detailed sequence of lessons incorporating techniques and procedures which have been successfully utilized in the field testing of the reading materials. Further testing of these instructional ideas and pedagogical procedures will continue during the course of field testing so that a manual of thoroughly tested techniques can be compiled at the end of the academic year.

Behavioral Analysis of Teaching Project

(0109)

Over the next five years this project will concentrate on increasingly detailed experimental analyses of teacher behavior leading to measurement instruments for assessing and instructional programs for shaping key behaviors. Theoretical interest will center on: (1) the extent to which complex interactional skills can be analyzed into distinct behaviors which can be independently shaped or controlled through appropriate experimental procedures, (2) the extent to which, through appropriate discrimination training procedures, adults can learn to monitor and "edit" their own performance in interactive situations, and (3) the role of various forms of "modeling" and feedback in shaping interactive skills. Studies exploring these questions will form the basis for development of practical teacher training programs. Work on such training programs, conducted by the PEP, IPI, and Follow-Through projects, will proceed in parallel with the basic research work.

Project Plans

Plans for the coming year include a replication, with some modifications, of last year's experiment on the effects of discrimination training and experimenter feedback, and the beginning of a series of experiments designed to determine the effect of various components of the discrimination training procedures. The replication experiment will use two groups, one receiving discrimination training and the other not. Both groups will practice with children and review videotapes, but neither will discuss their performance with the experimenter, in order to test the "self-editing" hypothesis more sharply. An improved training tape is being prepared, which will focus explicitly on each of several teaching skills specified in last year's analysis. In the replication experiment trainees will work on diagnosing chained behaviors as well as discriminations.

The following series of experiments will begin to explore the relative effectiveness of positive and negative "models" in the training tape, and of the roles played by tape segments in which the trainee focuses on the child's behavior and segments in which she focuses on the teacher's behavior. Other experiments will separate training on different subskills in order to determine the extent to which these subskills are behaviorally independent of one another. Specific questions for investigation will be chosen on the basis of results of the current experiments.

Each of these studies will involve presenting different training tape segments to different subjects, or to the same subject at different times. Insofar as possible, continuous scoring of practice sessions with children will be substituted for formal pre- and posttest sessions. This will permit us to compare learning curves rather than absolute scores and will also allow individualized adaptation of the training program where experimentally appropriate. In conducting these studies, several different experimental designs will be used. Of particular interest will be the use of multiple-baseline and other within subject designs which will permit us to eliminate costly control groups.

The laboratory facility and videotape library will also be used in developing training programs for PEP, IPI, and Follow-Through teachers who are practicing diagnostic skills in their individualized primary and preschool classes. Programming strategies for these groups will continue to be revised on the basis of results of the laboratory experiments.

Pre-School Skills Project

(0110)

We are presently in the midst of the development of a preschool curriculum for basic skills. The overall plan is to create a fully programmed series of learning experiences, which will establish the fundamental skills most important in profiting from subsequent regular school experiences. The full set of programs includes:

1. Basic language and concepts -- teaches children to make positive and negative statements about objects.
2. Syntactic discrimination -- teaches children to discriminate singular and plural nouns, present and past progressive tenses, subject and verb agreement, and positive and negative sentences.
3. Final consonants -- teaches children to discriminate between minimal pairs of words differing only in final consonant sounds.
4. Rhyming -- teaches children to find words that rhyme.
5. Directions -- teaches children how to follow directions usually encountered in their first school experiences.
6. Phonics -- teaches children basic phonic skills prerequisite to reading.

It is contemplated that the magnitude of this work from the student's viewpoint would amount to about one session per day of less than an hour's duration with the programmed materials. The overall strategy was to examine a variety of sources and explore a number of techniques and skill areas to determine the best possible coupling of programming technology and necessary behavioral competencies useful for students. The programs are most specifically being designed for the normal students who need it most, namely, children of poor families and children from black communities who must prepare to enter schools geared toward demands set by the dominant middle class culture.

Development of the programs follows the strategy of programmed instruction with its cycles of testing and revision and testing. Following completion of this phase, the total curriculum will be evaluated in a classroom setting with minimum contingency management procedures and procedures to assure overall free development of each student's unique characteristics and strengths.

At this point in time the first four programs outlined above are in an advanced state of testing for the more sophisticated machine versions and are presently being considerably revamped to a form more suited for large scale use. The fifth and sixth programs are in the preliminary programming stage.

The next year should see final testing of a simplified form of the first two-thirds of the curriculum and the remaining third in its early development stage with preliminary writing and earliest testing in the laboratory machine version. The second year (1971-72) will see the last third of the program undergoing several cycles of revising and testing as needed and preparation of material in the simplified versions. In addition, during this year initial use in a regular classroom setting will begin with this period of time being devoted to solving procedural problems adding what contingency management may be necessary, etc. The third year (1972-73) should see the total integrated curriculum evaluated in the school situation.

Project Plans

The classroom version of four of the preschool programs should be ready for testing during this budget year. The four programs teach: (1) basic preschool concepts (e.g., color, size, shape, inductive reasoning, categorization, (2) syntactic comprehension, (3) auditory discrimination of final sounds, and (4) rhyming. The programmed material will be presented via the Appleton-Century-Crofts Audio Frame System, and the students will respond by writing their answers with a special marking crayon in chemically treated booklets. The booklets are designed to have high interest value for children, and for this reason the program formats differ considerably from their machine counter

Since this constitutes a radical revision, extensive testing will need to be done, and on the basis of these results the programs will be completed.

Also during this year, a preliminary draft for the laboratory version of two other programs will be written. The first program will teach children to follow classroom directions. Criterion items will be written using the directions found on standardized tests which preschoolers often take. Children will be taught to follow directions like:

1. Open your booklet.
2. Draw a circle around.
3. Draw a line under, etc.

The second program will teach children phonics. It is expected that this program will teach the names of letters, the sounds each letter makes and other basic phonics skills which are prerequisite to reading.

COMPUTER-ASSISTED INSTRUCTION PROGRAM

(03)

The long-run objective of this program is to contribute to the continuous improvement of subject-matter learning, according to specifications derived from the requirements of individualized education. More specifically, the objectives are: (1) to develop experimental CAI curricula and, with them, to conduct both laboratory studies and small-scale field studies of the requirements of individualized school environments, (2) to investigate appropriate student consoles and computer languages for experimental course design, (3) to install an operational version of a system for computer management for teaching and research in an individualized school, and (4) to install student consoles and a system for computer-assisted instruction in certain subjects coordinate with and supported by the above computer-managed instruction system, with a small satellite computer installed at an elementary school.

Thus the program now is engaged in gaining experience with the psychological, pedagogical, and administrative facets of individualization, while gradually building up a small-scale experimental computer facility for integrated information processing, student testing, and instruction. The program's projects, which currently are producing this experience, are Curriculum Design, Pedagogical Languages, Engineering Research and Design, and Computer Facility.

Curriculum Design Project
(0301)

The Curriculum Design Project in the Computer-Assisted Instruction Program has as its objective the development of materials and study of their use in computer instruction. To this end, the project designs instructional units which are used as vehicles for experimental study of practical applications and learning variables. A major instructional problem attacked in this project calls for investigation of ways in which instruction can be optimized by adapting to the learning histories of the individual student. The details of how learning history is measured and the instructional decisions made on the basis of this history is a fundamental problem in CAI and the individualization of instruction in general. A second major problem is concerned with the development and investigation of CAI techniques which allow the student a high degree of subject-matter manipulation not possible by conventional means.

Over the next five years, the major portion of project work will be a part of an integrated effort of a number of LRDC projects to (1) investigate computer feasibility and requirements for individualized instruction in the elementary school and (2) design a prototype system which integrates the use of computer processing for the management of instruction, for testing, and for instruction. The model around which this integrative effort is to be based and preliminary work are described in Cooley & Glaser, 1969.

Project Plans

In particular, during the coming year, the project will be involved in three endeavors: (1) the development of computer-assisted instruction lessons in spelling and mathematics; (2) the conduct of research studies in the context of these lessons and other specially developed instructional sequences; and (3) the continued study of a computer-assisted laboratory in statistical inference. CAI lessons will be developed to serve two functions: (1) to provide adaptive instructional sequences for various subject matters in the elementary school and (2) to gather data relevant to curriculum design and to the study of learning processes in school learning. The CAI lessons will be designed in two areas: elementary mathematics and spelling to be remoted from the LRDC's Computer Facility to the Oakleaf School.

Spelling -- With respect to the Spelling program, two phases of development are planned. Phase I will involve a redesign of the current LRDC Spelling program. This revision, currently underway, is based upon data collected from recent user testing. The revised program will retain several former exercises, e.g., the basic branching logic and the same feedback as in the existing Spelling program. Changes from the current program will be made in five areas: (1) The words to be presented in the revised Spelling program will be more carefully monitored so that words presented in sequence are exemplars of the same spelling generalization rather than exceptions, since the exceptions appear to interfere with the learning of the generalization.
(2) Provisions will be made for spaced review; although this may or may not be done via CAI, it will be integrated into the Spelling curriculum. (3) Spelling exercises which the data show to be redundant with other exercises and less efficient teaching exercises will be eliminated. (4) Various audio delays and unnecessary audio prompts will be eliminated. (5) The revised program will be structured in such a way as to permit more efficient data storage. The revised program will provide the same drill and practice logic as the existing program, but in a more efficient form.

Phase II will consist of the construction of a Spelling program which is more tutorial and generative in nature. The psychological and computer function rationale for this program is currently in the development stages; it is anticipated that the following features will be considered for inclusion in the program:

1. Student history file. Each student will have a separate and unique data file that exists from session to session and throughout the duration of the course. Student specific data will be stored in this file (such as words misspelled). When a student sits down at the terminal, his permanent file will be opened along with another temporary scratch file. The permanent file will be the source of input data such as words misspelled in earlier sessions as well as other decision parameters that will be developed. The scratch file will be the temporary repository of the data generated during the course of the session. At the end of the session or during operations time later in the day, the permanent student history file will be updated with data from the temporary file and two types of reports printed on each student. One will be generated from the data found in the temporary file and the other will be derived from the permanent file and will report summary statistics on the student's performance to date and will provide the researcher and teacher with summary data on all previous sessions. Following the completion of this file update and report operation, the permanent file will be closed and the temporary file closed and deleted. Periodically, or upon request from the researchers involved, a third report will be generated on the entire course based on the permanent history files of all students participating in the program.

2. Answer processing. Answer processing will analyze the specifics of all incorrect responses and will retain them in each student's permanent file. This will enable the program to present in later sessions words previously misspelled and will provide the necessary data for analysis of error patterns. Ideally, an incorrect response might be evaluated in two phases. In the first phase, the student's response will be compared with a correct copy of the word stored in the data. If the response is evaluated as incorrect, answer processing will continue into a second phase. In this phase, the details of the response will be passed to a series of evaluation modules

which will scan the response and attempt to classify the error according to some error classification scheme. One module will be available for each error type (e.g., "ei" and "ie" inversion). The incorrect response will be passed from module to module with each module scanning for its own particular error pattern. If a match occurs in any evaluation module, the error-type data is stored in coded form in the student's permanent file. If no match occurs, this fact is noted and the word stored in an unclassified list. If any error-type occurs more than a criterion number of times over a specified time period, the program module responsible for the selection of words for presentation from the data base will be notified and the logic used in the selection of words altered.

3. Variable word lists. The present Spelling program is built around a permanent and fixed-sequence word list. Since the teacher is able to specify the starting word for each session, a minor degree of individualization exists since the student is then free to proceed at his own pace independent of any other student. However, progress through the word list is linear and all students are exposed to all words at some earlier or later time. The method described here for the revised program implies that the data base be more highly structured and that the student's progress through the data base need not be linear. This brings up the issue of whether or not there is a basic word list that all students of a given grade level should be exposed. The revised program, however, assumes that all students should not be exposed to a fixed word list and that word selection should be in part based on error patterns unique to each student.

The word data base will be structured to conform to certain principles of spelling. Words illustrative of a spelling principle will be grouped together or tagged with an identifying code. The word selection algorithm will then operate partly in a linear fashion and partly as a function of error pattern data maintained on each student. The error evaluation modules will notify the selection module that a given error type has occurred more than a criterion number of times.

The selection module will then begin to introduce words from the data base subset with which the student is experiencing difficulty. Each time the student correctly spells such a word, the Phase I evaluation module will update the permanent data file. Thus, if the student is able to exhibit some criterion level of proficiency with a word type with which he previously experienced difficulty, the selection module will be notified and will reduce to a normal level the student's exposure to that particular subset.

4. Branching. Branching in this revised program will be both a function of the student's most immediate response as well as error-pattern data. The branching algorithm will interrogate the student's history file to determine if an inability to correctly spell a particular word is part of a more general error-pattern. If this is found not to be the case, the program might merely enter a drill sequence such as occurs in the present Phase I program. If the error is part of a general pattern, the program might branch to both a drill sequence (on the particular word) as well as a remedial exercise which treats the spelling principle involved. This remedial exercise might attempt to force the student to realize the spelling principle inductively or it might treat the rule explicitly.

It is further anticipated that certain behavioral characteristics of the program will be investigated for their potential as principles in the design of instructional sequences: (a) Spelling words will be grouped according to the spelling rule which is consistent for a particular class of words. The words in this class will be treated as instances of a general concept. Treating the teaching of spelling rules as a concept formation task suggests a number of approaches which come out of the concept learning literature. For example, since in concept learning it is known that negative instances of a concept result in less efficient learning than an exposure to positive instances, then it can be hypothesized that words which are negative exemplars of the particular spelling rule being learned should be minimized in order to produce a higher learning rate of the spelling rule involved. (b) Laboratory work in verbal learning suggests that subjects code and organize memory in different ways. Similarly, large individual differences must exist in the ways in which students learn and retain correct word spellings. It seems possible to develop procedures for studying the retention strategies that different individuals employ by using a free-recall technique. If such individual strategies can be identified, the instructional sequences can be adapted to these differences. (c) Certain spelling research studies have suggested the facilitating effect of allowing learners to see the errors they have made and to make an overt correction. The current Phase I Spelling program adopted the strategy of not allowing learners to see words spelled incorrectly. Experiments will be set up to investigate this kind of feedback in spelling lessons; for example, errors may be suppressed so that the learner can type only correct responses, or feedback might consist of emphasizing incorrect letters, or of emphasizing incorrect letters and then requiring a correction response. (d) Data collected from the pilot Spelling program suggest that measures other than incorrect spelling errors might be useful for branching decisions. For example, learners may type bursts of letters in a word and then pause and type another burst. These bursts can be detected by an analysis of response latencies and may be suggestive of the way in which learners retrieve spellings from memory or the way in which they map graphemes onto phonemes.

Mathematics -- CAI lessons in Mathematics will fall into two general categories: MATHPAK and MATHGAMES. These two developments will consist of lessons relevant to the individualized curriculum of the Oakleaf School and to elementary school curricula in general. MATHPAK will contain a series of lessons, both of a drill-and-practice and of a tutorial nature, that will represent sequential developments of subject matter topics in elementary mathematics. This series of lessons will be integrated into the IPI computer-managed prescription system so that a student with a particular prescription can be entered into the MATHPAK series at various points depending upon the prescription. In addition, subunits within the MATHPAK will be designed so that the sequencing of topics within MATHPAK can be varied in an experimental manner in order to test alternative, hypothesized instructional sequences. From the point of view of computer programming, MATHPAK will be considered an "instructional processor" which will consist of a basic monitor, a common subroutine package, and a library of modularized CAI programs. At a time-sharing terminal, the user will request to enter the MATHPAK subsystem. A MATHPAK monitor will assume control and will permit the user to call up any program in the MATHPAK library.

MATHGAMES will consist of CAI programs that will provide students with practice in the manipulation and application of mathematical concepts of algorithms for the maintenance of and further exploration with these concepts and skills. Currently, MATHGAMES programs are being developed on prime numbers and on the partitioning of sets. MATHGAMES will be particularly oriented toward the exploration of how children interact with basic mathematical concepts which may or may not be explicitly treated in the elementary school curriculum, for example, the concept of a limit, the concept of permutations, etc.

A guiding psychological principle in the design of the CAI Mathematics lessons will be to facilitate learning by employing the reinforcing properties of stimulus change. Studies have shown that changes in a stimulus display contingent upon learner performance is highly reinforcing to the learner and encourages curiosity and exploratory behavior (Berlyne, 1960; Fowler, 1965). The subject matter of mathematics is particularly suited to such feedback changes as a result of learner manipulation. Since stimulus change can be defined by mathematical algorithms, it is possible to structure CAI lessons so that computer logic can be used to generate the stimulus change. This generative property eliminates large data stores which characterize CAI programs in other subject-matter areas.

A second guiding principle in the design of CAI programs is to make provision for data collection relevant to the analysis of how learning occurs in school subject matters. Within the context of the CAI lessons which will be developed, data will be collected to study learner behavior. Particularly to be emphasized are: the analysis of sequential responses; the manipulation of instructional sequencing in order to optimize transfer; and the analysis of response histories in order to determine the kind of data that are the most relevant to store in order to make effective instructional decisions.

Special instrumentation and programming features in CAI instructional design will continue to be investigated using specially developed instructional sequences such as the lessons on Introduction to Numbers and Timetelling which have been developed by the project.

Laboratory in Statistical Inference -- Following extensive use of the CAI laboratory exercises in statistics developed by this project, next year's efforts will be devoted to further increasing the effectiveness of the laboratory. Two avenues will be explored: (1) One is to investigate the use of a more flexible student terminal. Monte Carlo experiments will be moved to a Sanders CRT terminal in order to see whether they are more effective than they have been with a typewriter-terminal approach. (2) The other is the development of a battery of computer-administered tests which will help to further individualize instruction in statistical inference. At the present time, although students work individually at a terminal, all students take the same laboratory exercise in the same week and have the same lecture and assignment. The long-range intent behind the implementation of a computer testing procedure is to redesign the course into a type of individually prescribed instruction in which the computer does the testing, supplies the laboratory experiences, and indicates suggested readings and paper-and-pencil exercises based on the outcomes of the computer-administered tests.

Pedagogical Languages Project
(0303)

The objective of this project is to develop computer programming languages which facilitate the writing of programs for CAI lessons and on-line psychological experiments. Of concern are such characteristics as readability, ease of modification, training requirements, compiler efficiency, and generality.

Project Plans

During the coming year, the Pedagogical Languages Project will pursue two major lines of endeavor.

1. Developmental work will continue on an advanced general-purpose programming language designed to meet the programming requirements of an on-line behavioral science laboratory. The language will be implemented as an interpreter able to run in a conversational mode permitting on-line, interactive debugging. The language has been tailored to meet the I/0 requirements of the LRDC Experimental Time-Sharing System (ETSS) currently under development in which particular attention has been paid to device independence. Under ETSS, for example, the I/0 handler controlling the touch-sensitive surface will not return to the user a difficult to interpret binary value as is currently the case but rather an ASCII character-string giving the number of the window touched. This character-string will be identical in format to those generated by teletypes or CRT terminals thus making the touch surface similar to those devices from a language and user standpoint. The design phase is expected to continue to mid-year with actual implementation to begin July, 1970. Since the language has been structured to permit a phased and upwardly compatible implementation, the language will be put into use as soon as key portions have been implemented. An operational subset will be available by December, 1970.

2. Work will begin on the exploration, design, and implementation of one or more interactive programming languages designed

specifically for a small-scale, CAI-oriented time-sharing system. This effort differs from the one described above in that a small-scale system offers only limited core memory which imposes the design requirement that the language processor (e.g., compiler, interpreter) be as compact as possible. For this reason, languages which possess recursive capabilities are being explored. The first phase of this effort will be the implementation of a TRAC interpreter capable of running under the Oakleaf Time-Sharing System. Depending upon the availability of hardware, an operational version is expected by December, 1970.

Engineering Research and Design Project
(0304)

The major objective of the Engineering Research and Design Project is the pursuit of technological improvements and innovations in the design and construction of CAI student terminals. Given only limited resources, the project is a focused effort that seeks to apply existing and newly developed technology to the problem of developing enriched, yet economical, student stations.

Project Plans

A major project of the Engineering Research group will be the further investigation of the properties of touch-sensitive surfaces. During the past year, a prototype surface operating on a photo-electric principle was successfully constructed and tested, and efforts will be made during the coming year to refine and enlarge the surface in preparation for its eventual integration into an enriched student station. Further development work will be done on a second prototype which operates on a contract closure principle and an evaluation will be made of its relative cost, durability, and flexibility.

Several components of an enriched student terminal developed by Donald Bitzer of the University of Illinois are expected to be delivered late in 1969. Using both these components and an advanced design touch-sensitive surface, the Engineering Research group will be responsible for the construction and evaluation of an enriched terminal incorporating touch-sensitive, audio, image-display, alphanumeric display, and keyboard components. If the design proves successful, the group will have prime responsibility for procuring and constructing the first operational stations. However, if a decision is made to produce additional terminals in quantity, these terminals will be manufactured by some outside commercial concern for LRDC rather than by the Engineering Research staff.

Given limited resources, it is important that the Engineering Research group emphasize developmental work and not become involved with large-scale production problems.

Computer Facility Project
(0305)

The purpose of the LRDC Computer Facility is to provide computer support for on-line psychological experimentation and for research and developmental study of computer-assisted instruction. In both of these types of activities it is necessary to have a flexible facility with more control of scheduling, hardware, and systems software in the hands of the researcher than is possible when using a general purpose university computer facility.

Project Plans

Great progress has been made during the past year towards improving the overall performance and throughput of the Computer Facility. A total reorganization of the Software staff and extensive modifications to the PDP-7/9 Time-Sharing System have resulted in a fully operational system and a marked increase in applications programming output. System reliability has been high particularly for an experimental system, and time-sharing system up-time during the summer, 1969 has averaged 98% plus.

Given this base with which to work, emphasis during the coming year will be in the following areas:

1. Improved terminal reliability. A hardware effort will be made to improve both CROW (audio) and student terminal reliability.
2. Expanded terminal capability. Additional student stations of the teletype, alphanumeric display, and graphic display types will be interfaced and installed which will increase both experimental capacity and flexibility.
3. Increased remote terminal capability. Greater emphasis will be given to increasing the system's remote terminal capability which should serve to partially remedy problems faced by experimenters in obtaining subjects as well as permit experimentation in a conventional school environment.
4. Improved programming language capability. To increase applications programming output, one or more higher-level languages are planned for implementation during 1970.

5. More powerful time-sharing system. To permit the full exploitation of the computing power available in LRDC's PDP-7/9 system, a more sophisticated and powerful time-sharing system will be installed during the year which will increase by a factor of ten the maximum number of possible student terminals.

6. Improved hardware reliability and documentation. During the coming year, major areas of the hardware system will be rebuilt in order to correct the great amount of poor and sub-standard work done in the past. Particular emphasis will be given to improving the input/output structure.

EDUCATIONAL FIELD STUDIES PROGRAM
(04)

The long-run objective of this program is to acquire knowledge derived from the study of natural state schools which is relevant to the development of procedures for adatping education to differing characteristics of students.

Field studies are carried out both by persons specifically assigned to projects identified with the Educational Field Studies Program and by persons working on various aspects of development projects who have encountered opportunities and needs for school-based research. Studies of the latter type, currently underway and projected for the coming year, include investigations of learning style as related to the use of lesson materials, a study of the effects of a modified contingency management system in an ongoing classroom, an investigation of the effect of certain types of academic counseling on the performance of elementary school pupils, a study of selected analytical procedures as tools for the development of instructional hierarchies, and pilot investigations of improved techniques for the diagnosis of learning difficulties.

The major formal project of this program is the Measurement and Evaluation Project, which currently employs IPI both at the Oakleaf pilot school and at the growing number of field testing schools as its principal object of study for the investigation of problems in and for the development of improved procedures for both formative and summative evaluation. This project is also concerned with the theoretical and applied aspects of test development for the individualization of education.

Measurement and Evaluation Project
(0402)

The Measurement and Evaluation Project is concerned largely with evaluation procedures that contribute to the improvement of educational programs under development at the Center. Most of the activity of the staff is currently centered on the IPI Project. Up to this point evaluation in IPI has been devoted largely to obtaining data for use in the development and implementation of all aspects of this innovative program. Studies carried out during the past few years have analyzed the operation of IPI and have provided an interim assessment of the results of this type of instruction. These studies have then provided feedback which has been important in the modification of the program as it is being developed, and have also provided data indicating areas where major revisions and improvements would be desirable. As a result, decisions have now been made to undertake some major changes in the overall program for Individually Prescribed Instruction. It is anticipated that in the next few years the activities of the evaluation group will center on procedures for contributing to this improvement process.

The basic problem to which the evaluation group will be addressing itself can be phrased in terms of specific questions.

1. How can evaluation activities contribute to the planning activities of a development program?
2. How can evaluation contribute to the monitoring of planning and development activities?
3. How can evaluation provide information which will be useful in improving planning and development activities as they are being carried out?

It is assumed that answering these questions will help to make a contribution both to the improvement of the IPI procedures as a specific educational program and also to the formulation of guidelines for evaluation activities which would be useful in connection with any type of educational program.

Project Plans

Basic objectives of the evaluation program can be considered as providing answers to the questions posed above. To do this evaluation staff members will work closely with members of the various development teams working on the IPI Project. Their work involves the establishment of guidelines for planning and development activities. They will be seeking to determine the best procedures to use in each aspect of planning and development. When such guidelines have been established, the evaluation staff will monitor their use by each of the development groups. This monitoring will help to insure that development activities are carried out in accordance with desired procedures and will also serve as a basis for revising the guidelines. It is assumed that over the next several years this procedure could lead to the development of a set of procedures for use in curriculum development projects. This could include guidelines for the development of curriculum objectives, for the planning and tryout of instructional materials and tests, and criteria for the development and modification of classroom procedures. It should also lead to the establishing of evaluation techniques for monitoring such guidelines. During the past year work has been done on the development of such procedures for the statement of instructional objectives and for the initial tryout of lesson materials. In the coming year major attention will be given to the production of companion procedures for the planning and writing of lesson materials, for the initial evaluation of the effectiveness of new lessons, and for use in the development of a program for modifying classroom instructional procedures. Work on such guidelines will be accompanied by work on the development of evaluation devices for assesing the implementation of such procedures and evaluating the results of such an implementation.

The basic model that guides the formative evaluation efforts of the evaluation staff has been outlined by Lindvall and Cox (1969). The continuing work of the staff involves a further implementation of activities that are suggested by this outline. This model puts a heavy emphasis upon the evaluation of the plan of any development activity and an evaluation of the operation of any new program. In carrying this out it has been found necessary to work very closely with the developers. Frequently this results in an integration of the evaluation and development staff. What this really means then is that there is at least one member of the development staff of each phase of the project who has a continuing concern for the evaluation of every aspect of development work. One important impact of the Evaluation Project upon the IPI Project has been the integration of the evaluation activity into all aspects of development work. This is essentially what is meant by formative evaluation.

As suggested above, the expected outputs of the evaluation program include both an improved program for Individually Prescribed Instruction and the development of new knowledge and new procedures for the use of evaluation activities in the production of a new educational program. In the next few years it should be possible to provide data concerning the extent to which certain procedures were carried out in the development of various aspects of the IPI program. Such information concerning the development process has some parallel in the standardized testing field where test manuals provide information concerning such things as the outline used in developing a test, the item development procedures, item selection procedures, standardization procedures, etc. The evaluation staff hypothesizes that the provision of such information concerning any new educational program will become a part of the data that will be sought by the person who is considering the adoption of the program. Also, the provision of tested guidelines for various aspects of the development process could be a major contribution to future work on programs of this type. A similar contribution might be found in the tested evaluation procedures that will emerge.

That the evaluation activities of the Center and particularly those activities in connection with the IPI program will have some impact on the educational scene in the future is already indicated by the fact that members of the staff have been involved in a variety of publications regarding their work and are members of the advisory and consulting groups for a variety of evaluation programs.

Decisions and Values Project

(0405)

The educational needs of students cannot be met completely by curricula designed only to help them learn subject matter and acquire learning skills. A fundamental aim of education, according to John Dewey, should be to enable the individual to "reconstruct his experience." Such reconstruction adds meaning to immediate experience and increases the individual's ability to direct the course of his subsequent experience. The learning of subject matter is only a tool in this process. Reforms in method such as individualized instruction, are likely to help students to acquire knowledge more efficiently and, to a lesser extent, to reconstruct what they learn within a personal frame of reference. As students progress through primary grades and into secondary and higher education, however, the relation between what they learn in the curriculum and what they experience in their personal lives becomes increasingly complex and problematic.

The Decisions and Values Project is addressed to certain aspects of the problem of helping students to transform their educational experience into personally relevant terms. It deals with the development both of personal values and of the ability to engage in effective decision-making. The project is concerned not with the inculcation of specific values but with how individuals may learn to formulate and to choose among value alternatives. It is postulated that such value formation and decision-making can be influenced systematically by creating appropriate individualized learning environments in the school. The project involves both development and basic research activities.

A specific program being developed within the Decisions and Values Project is the Coordinated Information and Guidance System (CIGS). The purpose of this program is to provide school situations in which each student can examine and clarify his personal values, and learn to make informed, responsible decisions about education, work, and personal living. The basic research associated with this program is concerned with value formation and decision-making behavior.

The CIGS was conceived to complement regular instructional programs in the school. Its basic organizational unit is a group of about 15 students and a group leader. The latter functions as a permissive collaborator rather than in the traditional teacher role. In addition to having a philosophy and guidelines for conducting the CIGS groups, the group leader is provided with a sequence of exercises in which the participating students analyze certain conditions requiring value judgments and personal decisions, and each assesses his own related abilities and value orientations. To date, the CIGS program has been tried out and developed in rural, suburban, and urban high schools.

Project Plans

During the coming year the work of the project will shift toward a greater involvement with the Center's Individualization of Education Program. Until the exact nature of this new development effort is defined, this project will have a minimum staff and will be transferred to the IPI Project.

INDIVIDUALIZATION OF EDUCATION PROGRAM
(05)

The long-run objective of this program is the development of prototype systems of education which, by adapting to relevant individual differences, optimize each student's progress in school and permit achievement of educational goals in the most efficient manner for each student.

Its short-run objective is the development of experimental schools where techniques for individualizing instruction are instituted, investigated, refined, and demonstrated; the techniques are analyzed in detail in order to discover, with progressively greater precision, what individual differences are relevant and what instructional alternatives are needed. In the experimental schools, the educational institution and its instructional procedures and materials are designed to be adaptive to the learning characteristics of students in contrast to conventional schools where the students are required, for the most part, to adapt to the system.

The Individualization of Education Program currently consists of three principal projects. Two of these, the Individually Prescribed Instruction Project at the Oakleaf Elementary School in the Baldwin-Whitehall School District and the Primary Education Project at the Frick Elementary School in central-city Pittsburgh, are concerned with the instructional programs in experimental schools. The third project, the Computer Management Project, is concerned with developing a computer system that can facilitate certain of the management, testing, and instructional functions of individualized educational systems. This project is now under development at the Oakleaf School and, as future progress warrants, will move into the Frick School.

Individually Prescribed Instruction Project

(0501)

The long-term objective for Individually Prescribed Instruction is to develop a prototype system of individualized education which, by adapting to relevant individual differences, can optimize each student's progress in school. Although the need for such a system has been well-documented for the past 50 years, the recent advances in the behavioral sciences and in technological development has stimulated educational innovations during the "sixties." Previous attempts at modifying the schools' structure have been useful in providing insight concerning what is possible; however, none of these went far enough in modifying school structure to result in individualized schools as defined here. This fact coupled with society's commitment to the significance of individual performance suggests that education must permit the development of individual talent as well as provide an opportunity for students to utilize and strengthen theese talents through programs of studies designed for individual students. In order to meet this objective the Center has established an experimental school, in cooperation with the Baldwin-Whitehall School District, where procedures for individualizing instruction have been instituted and where continuous refinement and improvement can take place.

Based upon our experiences to date, future plans call for continuing research and development activities which can contribute to the evaluation and redesign of procedures leading toward an instructional system that can adapt educational practice to individual requirements. Since an important aspect of the IPI procedure is provision for continuous modification of curriculum, materials, teaching practices, and feedback regarding student performance, a projection of plans for the next five years basically involves a continuation of the developmental effort. These long-range plans call for a concentration on certain specific types of activities which can be described under the categories of: curriculum, testing, materials, management, and teacher training.

Project Plans (Five Year Projection)

Curriculum -- Since the fundamental requirements of individualizing instruction is that curricula be stated in measurable and assessable terms, the major tasks in curriculum development will involve: (1) modifying and redefining the curriculum areas presently used in the IPI system (Mathematics, Reading, and Science); (2) the upward extension of the present curriculum into what is typically taught or could be taught in the seventh and eighth grades and beyond in order to extend the "ceiling" for more able students in the elementary school as well as preparing to introduce IPI procedures into the present seventh and eighth grade; (3) extension of the IPI procedures into other curriculum areas such as perceptual development, language arts, and social studies. These efforts all require long-term commitments on the part of the Center and reflect a change in emphasis from attempting to individualize existing, more conventionally stated curricula to the specification and development of curricula in terms of the demands of individualized instruction.

Testing -- The fundamental task of the testing and measurement staff is to identify and develop instruments which can provide information for decision making in four general areas of instructional development: (1) analysis of subject-matter domains under consideration for curriculum development; (2) measurement of learner characteristics to be used in the diagnostic process; (3) measurement of the effect of instructional environment as it relates to learning; and (4) evaluating the learning outcomes. In this context, measurement in learning and instruction is concerned with providing data, assessments and information about the nature of learner performances, instructional conditions, and the learner himself. For this reason, the testing staff is involved in all aspects of developmental work of IPI. Over the next five years, the emphasis in testing will be on: (1) the development of definitions of tasks which precisely specify the domain of instructionally relevant tasks to be accomplished by a learner in the curriculum areas under study; (2) the validation of curricular sequences of instruction in each of the curriculum areas; (3) the refinement and modification of diagnostic tests presently used in order to provide information related to student error patterns for use in instructional treatment; (4) the development of measuring instruments which will be predictive of pupil success under differential instructional treatment; (5) the continued exploration of a computer-based testing procedure for diagnosis and placement of students in each of the curriculum areas; and (6) the development of a criterion-referenced achievement test which can accurately reflect the outcomes of instruction.

Materials -- The Center staff concerned with materials development in each of the curriculum areas will continue to experiment with and incorporate into the program various types and kinds of materials for individualizing instruction. This effort will include an investigation of improved paper and pencil materials, various types of recorded lessons, filmed lessons, and a combination of all these for particular purposes. In addition to these efforts considerable attention will be given to materials which stress problem-solving competencies and student inquiry. Currently, inquiry is a prominent theme in educational reform. Many curriculum projects in science, mathematics, and social studies focus on this as a theme. To bring inquiry into IPI there is a need to adapt the IPI model to achieve individualized learning of inquiry. To accomplish this, sequences of inquiry units will first be developed and tested in mathematics and science, achievement subtests will be constructed for assessing the competencies in planning and conducting inquiries, and laboratories of materials will be identified and/or developed to teach the desired behaviors. As the materials become available and are tested, these units will then become an integral part of each of the curricular areas.

Classroom Management -- Developmental efforts for the improvement of classroom management procedures for IPI will continue. Efforts to implement and expand the Computer Management Project into IPI will concentrate on providing up-to-date information to teachers, providing suggested prescriptions to students, and providing a means of placement and diagnostic tests to students. Related to these management activities will also be the first steps in providing selected learning sequences through CAI.

The second major developmental effort will be the investigation and implementation of a systematic reinforcement program into the IPI classrooms at the Oakleaf Elementary School. This work, which began during the 1968-69 school year, will require at least one additional year of experimentation followed by a year's development of the necessary specifications and procedures for training teachers to properly implement and manage this program. Along with this endeavor will be continued efforts to specify the roles and functions of teachers, para-professionals, and students in an individualized program.

Teacher Training -- Over the next five years work will continue on developing, implementing, and evaluating a basic teacher education program for individualized instruction in the elementary school. In the past, the teacher training activities have been limited to training teachers for IPI and specifically within the Oakleaf School. In the future, these activities will be expanded to design a teacher training program, both pre-service and in-service, with the conceptual and methodological bases for individualizing instruction within different types of instructional programs. The need is to prepare the teacher to be able to cope with the requirements for planning, conducting and assessing individual teaching that involves different types of learning goals, students with differing abilities, and different types of instructional resources. The first steps in meeting this need will be to conduct a task analysis of the teacher's role in an individualized instruction program to determine the competencies that must be developed. From this will come the objectives which will serve as a basis for the general model with the competencies being obtained by independent study, observation, laboratory experiences, assisting trained teachers, and experiences in the classroom.

One-Year Projection

Plans for the next year in IPI can be separated into two types of activities. First, those activities that relate to the modification and immediate improvement of the system that can be implemented in the field-testing schools under the direction of Research for Better Schools, Inc. (the Philadelphia Regional Laboratory); and secondly, those activities that are related to more long-term developmental efforts that are more closely related to the Center's goals of experimentation in educational practices. Since these two types of activities do overlap, both types will be described under each of the following sections.

Curriculum Design -- In the areas of curriculum design, emphasis for the coming year will be: (1) continued revision and improvement of the present Mathematics, Science, and Reading programs based upon data from the 1968-69 school year; (2) the introduction of a Perceptual Development program into the kindergarten and first grades; (3) the field-testing of a new Beginning Reading program; and (4) the extension of the present Mathematics, Reading, and Science curricula into the next higher levels.

In Mathematics, work will continue on the specification of a new Mathematics curriculum emphasizing the structure of Mathematics as well as the computational skills. During this year it is anticipated that the objectives will be completed, tests will be constructed for the first two or three levels of the program, and work will begin on the validation of the content hierarchy. Because it is anticipated that the development of this curriculum will take at least five years, the Center will continue to revise and improve the Mathematics program currently in use in the IPI schools.

In the Reading program, curriculum design efforts will continue along the lines begun during the past year. In keeping with the Center's decision to develop curricula necessary for individualized instruction, the new decoding portion of the Reading program will be tested during this next year. While this is going on, the Reading staff will begin the identification and first attempts at structuring the objectives for the next portion of the program. In addition to these developmental efforts, work will continue on the validation of the sequences for library-reference segments of the Reading program.

The overall aims of the IPI Science program is the development of a complete individualized Science program which will serve every student from his entry into the elementary school to the beginning of high school. Present projections call for ten levels in the Science program divided into three phases: (1) the Exploratory Phase (Levels A to D); (2) the Inquiry Phase (Levels E to G); and (3) the Investigative Phase (Levels H to J). During the period February, 1970 to January, 1971, the development of Science will move across the curricular transition from the Exploratory Phase to the Inquiring Phase. This phase will include: (1) the application of process skills in problem solving; (2) accumulation of science knowledge; (3) concrete to abstract subject matter; and (4) formulation of empirical laws and principles. The major efforts will be in the specification of the objectives and the design of the instructional format for each of these larger goals.

As a result of the problems and findings of the first five years of developmental efforts, work will begin on the specification of a perceptual development curriculum designed to provide each child with the experiences necessary to acquire facilities in processing concrete information. In essence, the rationale of the curriculum accepts the premise that a child's ability to analyze, order, and reproduce concrete visual and auditory information is dependent, at least somewhat, upon a series of acquired skills and subject to modification. The basic goal of this program is to provide the child with the skills needed to process sensory data with a minimum of overt motor support. During the next year, efforts of Dr. Jerome Rosner and his staff will be to refine and validate the hierarchy of objectives for visual perception and the collection of information relative to objective specification of selected auditory skills related to perceptual development.

Testing -- Depending upon the progress in curriculum development the following are the objectives of the testing staff for the next fiscal year: (1) the analysis of pupil error patterns in IPI Mathematics and their relationship to instructional treatment; (2) an exploration of the feasibility of computer-assisted testing in selected areas of the Mathematics program; (3) the validation of selected instructional sequences in the skills continuum of the Reading program; (4) the development of placement and evaluative instruments for the Science program; (5) the development of more student self-evaluation techniques; and (6) the continued development of theoretical models which can be generally useful in programs of individualizing instruction.

Materials -- During the next year, emphasis for materials development will be centered on the development of materials to provide alternate approaches to selected units in each of the curricula areas. Through this approach, the Center hopes to obtain information to assist in the identification of various learning styles within and between students.

In the area of Mathematics, at least one alternate set of materials has been identified for each of 50 units of study. Next year we will be testing the appropriateness of these materials in terms of students' interest, learning outcomes, and ease of management within the system. Nearly all of these alternate materials have been selected from materials commercially available and include tapes, filmstrips, programmed learning sequences, and textbooks.

As a result of last year's study of materials available for independent reading in the IPI Reading program, a concerted effort was made to identify 400 additional reading selections divided into four levels of reading that could be coded to the system, geared to the interest of students, and easily obtainable commercially. During the next year, these materials will be evaluated in terms of the criteria of selection and additional selections will be identified to extend the offerings upward. In the skills development portion of the program, most of the paper-pencil activities presently in use for the teaching of library and reference skills have been deleted and actual materials housed in the library are being substituted for them. Also, study guides and directions for use will be developed as students move through the curriculum. In addition to these materials, we will be testing materials developed to our specification by the McGraw-Hill Publishing Company for the beginning reading portion of the program.

The Science staff will be testing the mainstream materials developed for Levels C and D at the Oakleaf Elementary School. In addition, new materials will be developed for Levels A through D to investigate the possibility of alternate approaches for materials development in the Science program. The present projections call for approximately 30 individual types of Science lessons to be developed for each of Levels C, D, and E with 100 additional lessons as alternate lessons for objectives in Levels B through D.

In the area of perceptual development, materials to be utilized by the classroom teacher in the area of visual perception will be developed and tested during this school year. In addition, we will begin to investigate the types and kinds of materials needed for eventual use in auditory perceptual development.

Classroom Management -- In general, the emphasis for the coming year will be the continued development of the computer management system and the investigation and implementation of a systematic reinforcement program. Because of the limitations of the hardware being utilized during the 1968-69 school year, we are now investigating the feasibility of introducing small on-site computers to handle the management demands of the IPI system. During this year, we will be investigating the hardware and programs necessary to change over from a time sharing system to the eventual in-school system.

Research will continue on the aspects of systematic reinforcement on student progress and efficiency. This effort will begin in one classroom and will be moved to one additional classroom as we are able to specify the teacher tasks required and how they relate to the other teacher functions presently required by the IPI system.

Teacher Training -- Since the functions of teachers in individualized instruction systems are quite different from those required under more conventional instructional systems, the IPI staff in cooperation with the PEP staff will begin a task analysis of teacher functions in order to build a more formal teacher training program for individualized instruction systems. During the next year, it is anticipated that this task analysis will be finished to the point where we can develop a taxonomy of competencies, knowledge, and qualities teachers in an individualized instruction program should possess. From this a model for a teacher education program will be developed along with the specifications for the types of experiences and materials needed for instruction. The LRDC staff working with the Oakleaf and Frick School teachers will identify the critical aspects of individualized instruction for the initial facilities of program development. The initial step in this identification will be in the area of diagnosing learning characteristics, long- and short-term planning for students and tutoring students with learning difficulty. This whole endeavor will attempt to bring together what has taken place at Oakleaf, the work at Stanford University on micro-teaching, and the experiences gained in the teacher education laboratory operating here at the Center.

Dissemination -- In order to meet the persistent pressures of educators throughout the nation interested in implementing or adapting IPI, the Center will continue to work closely with the Philadelphia Regional Laboratory. In addition to this effort, we will also continue to investigate procedures for involving industrial organizations in the development and implementation stages of the system. During the next year we will be working closely with Appleton-Century-Crofts, Inc. in Mathematics and McGraw-Hill Publishing Company in Reading. These involvements are an effort to provide resources and impetus to extend the capabilities of the IPI staff.

Summary

In general, the emphasis for the next year will be to improve the technological, psychological, and psychometric base of the IPI program. In addition to the increase in the research activities at the Oakleaf Elementary School, certain aspects of the PEP Project will be merged with the IPI Project to extend the capabilities of both projects. The problems that are of major concern and which will be investigated during the coming year are:

1. How can the diagnostic instrument be improved to provide more exact information to teachers and students?
2. What aspects of a systematic reinforcement system can be employed in an ongoing school?
3. What are the elements that must be included in a teacher training program to enable the teacher to individualize instruction effectively?

Primary Education Project
(0505)

The development of a model for individualized education at the preschool level is being done largely with the Primary Education Project (PEP), borrowing procedures and methods as appropriate from the Individually Prescribed Instruction Project (IPI) for the elementary school.

The PEP model has been under development at a single school in Pittsburgh for the past two years. Children in the project range from three- and four-year olds in Headstart classes through kindergarten, with a small number of six-year olds also included. Using this school as a base, the PEP staff is developing detailed curriculum and classroom management procedures appropriate for very young children of very varied backgrounds.

A preschool environment, which will meet the needs of all children for effective learning and participation in the society at large, must meet two requirements. First, it must assure an atmosphere in which children can become confident of their own ability to learn and to cope with their surroundings. Secondly, it must, through its program, help the children to become truly effective learners and copers capable of meeting real demands. Self-confidence based on an artificial lowering of all demands and expectations will evaporate as soon as the child moves out of the protected environment; only true competence will breed confidence that lasts beyond the schoolyard or the years of the special program.

Project Plans

During the 1970-71 fiscal year, work in the Primary Education Project (PEP) will focus on the following areas: (1) evaluation and revision of the 1969-70 curriculum, (2) new curriculum design, (3) basic learning studies, and (4) classroom management and teacher behavior.

Evaluation and Revision of the 1969-70 Curriculum -- During 1970, work will continue on developing and applying validation methods for curriculum hierarchies. New hierarchy validation methods will be applied to extensive sets of mathematics and classification data collected at Frick and Oakleaf schools. In addition to evaluating the PEP curriculum sequences, these studies will provide the procedural and substantive data necessary for further refining the new method and supplementing it with additional validation procedures as required. Dr. John B. Carroll, a member of our Board of Visitors, has been advising us in this work.

An intensive evaluation of the PEP perceptual-motor curriculum is also planned for next year. The perceptual motor curriculum developed under the direction of Dr. Jerome Rosner consists of three separate programs, one in general motor skills, one in visual analysis skills, one in auditory analysis skills. The visual and auditory programs, in particular, are thought to provide the child with a set of basic skills which will facilitate his learning other school subjects. To test this general hypothesis a series of studies will be conducted in which different groups of children begin work on parts of the perceptual-motor curriculum at different times. Repeated measures of performance on perceptual-motor tasks will be taken for all children and continuous records on their progress through math classification and reading curricula will be available through the project's ongoing data bank. These records will be examined, using appropriate statistical procedures, for changes in learning rate associated with the introduction of perceptual motor training.

Revisions of the math, classification and preceptual motor curricula will be made during 1970-71, in preparation for the start of the 1971-72 school year. These revisions will be based on data both from validation studies and from classroom use. In September, 1971, PEP will move into second grade at Frick School. This will require adaptation of the IPI Math and Reading curricula used in that grade to meet the special needs of Frick's urban population and to articulate with other aspects of the PEP program.

New Curriculum Design -- Curriculum development and revision during 1970 will focus on development of a language curriculum and of exploratory environments in several curriculum areas.

1. New language curriculum development during the coming year will focus heavily on language comprehension and production. The project's approach to language will be "functional" (i. e., the concern will be to develop skills necessary for effective communication, rather than to teach proper grammar or pronunciation.). Thus, there will be no attempt to force ghetto children to speak in "standard" dialect, although they will be taught to understand it, and to use it when communication requires. PEP's work on early oral language skills will be coordinated with IPI's work on written language so that after several years of developmental work, LRDC will have an integrated, individualized language curriculum suitable for children from three through eleven or twelve years of age. Children will be systematically taught comprehension skills using oral materials at the younger age levels, and these skills will be gradually transferred to written texts as the child learns to read.

A graded series of story comprehension skills, applicable to both oral and written language presentations, has already been developed by the PEP-IPI staff and will be used in a few classrooms on a pilot basis beginning this September. During the 1970 research year, these skill descriptions will be refined and tests written for each of them. Teaching strategies will then be designed, permitting the comprehension sequence to be integrated into the formal PEP and IPI curricula. During the same period preliminary sequences in other areas of language development, including speaking and writing, will be prepared; in subsequent years these will be refined and incorporated into the formal curriculum.

2. "Exploratory" environments for science and social studies. Educators today have become interested in the "free" or "open" style of education practiced in many of the English infant schools. Although the English methods of education sound attractive, there has been very

little systematic analysis of the methods or study of their effectiveness. Frick and Oakleaf schools, because their programs are individualized and yet research and data oriented, offer a unique opportunity to study the nature of "open-ended" instruction and to relate such methods of our more formal approach to individualization.

In order to conduct such studies we plan to develop several "exploratory environments" (areas supplied with equipment and materials needed for reading, experimenting with, and constructing materials related to certain science or social science topics). Possible topics for development are: (a) geography (both physical and political), (b) family structure, (c) housing and shelter, (d) electricity, (e) basic mechanics, and (f) animal or plant life. In addition to equipment and materials, suggested project activities in each area will be developed and a teacher will be trained to guide and assist children in learning from their project work. Following the English model, the intent is that work on any particular project be voluntary for the child and that he participate in planning and evaluating his work. To assess effectiveness of the approach, however, PEP staff will develop objectives and tests (including observational measures) suitable to each area. Inssubsequent years studies will be designed relating performance in the exploratory environments to progress through the basic skills curricula.

Basic Learning Studies -- Basic learning work during 1970 will concentrate on the further development and application of experimental designs for testing learning hierarchies, studies of the relationship between transfer and scaling properties of hierarchies, and refinement of behavior analysis procedures for generating hierarchies.

Experimental hierarchy studies will include follow-up studies in the areas of matrix classification skills and conservation of number. Other areas being considered for study are seriation, concept-formation, arithmetic "problem solving, " and class-inclusion logic. In each area studied previous research will be reviewed detailed behavior analyses conducted, and a group of studies designed to test the transfer relationships among a set of related behaviors. In addition to studying order effects, these studies will be designed to investigate the relative efficiency of practice on the "terminal behavior," as opposed to instruction in prerequisites and components, for various types of skills and various types of learners.

A related set of studies will seek to establish the extent to which the "scaled order" of a set of objectives (the order established by scalogram or similar methods) necessarily predicts the most efficient teaching order, and vice versa. To study this question, sets of objectives will be scaled and then taught in various orders, using experimental transfer designs. Other studies will explore the effect of instruction on scale relationships by comparing empirical scales for a set of objectives before and after instruction.

Throughout this work, considerable attention will be paid to refining and documenting the procedures for task analysis, which are the basis for generating hierarchies. At present, a two-stage procedure for generating hierarchies has been developed and distinctions between "components" (behaviors actually present during skilled performance) and "prerequisites" (behaviors which facilitate learning the terminal behavior but which are not necessarily present during skilled performance) have been made. Further exploration of the range of applicability of these procedures will be conducted during the coming year. A scholarly paper discussing theoretical and practical implications of these forms of behavior analysis is planned.

Classroom Management and Teacher Behavior -- In this area PEP will focus on experimentally analyzing the effect of specific aspects of classroom organization and teacher behavior and on further defining the various roles the teacher in the PEP classroom must fill. Studies of the following variables are planned: (1) effective types of reinforcement (material, social, points, evidence of progress, etc.) for different children and effective programs for "shaping" the child's ability to work for increasingly more "intrinsic" rewards, (2) units of work (attention to task, task completion, "unit completion," test passing, etc.) that are reinforced, and especially programs for developing the child's ability to work for longer time periods and complete larger units of work before being rewarded, (3) teacher practices affecting "social climate" (i.e., children's contact with each other, patterns of requesting and giving help, etc.). These may be reinforcement contingencies that reward joint (or individual) work, prescription strategies that stress working in pairs, styles of responding to request for help and other such variables, and (4) the effect of giving children control over record-keeping and some aspects of reinforcement distribution. In all of these studies, data on "time on task," task completion, and test passing rate, as well as on social climate variables where relevant, will be taken under changing treatment conditions.

The continuous use of all of these measures will permit us to study empirically the extent to which demonstrated learning (test passing) is a function of visibly working ("time on task" and task completion) in the classroom. Both "reversal" designs, where a treatment is removed and reinstated, and "multiple baseline" design in which treatments are introduced on staggered schedules, will be used. Both types of designs permit assessment of the extent to which changes in dependent variables are directly related to changes in treatment conditions.

Parallel to and supported by these basic studies will be work on behavioral analysis and description of the various tasks the effective teacher in the individualized classroom must perform. This work will also build upon the work done in LRDC's Behavioral Analysis of Teaching Project. As behavioral descriptions of teaching roles are developed, observation instruments will be developed for assessing teachers performance in each role. Whenever possible, the observation instrument will be validated by correlating teacher's performance with their children's learning. The instruments will then be used in training and assessing teachers learning to operate an individualized classroom, particularly teachers participating in LRDC's combined PEP-IPI Follow-Through model.

Computer Management Project

(0506)

The overall objective of the Computer Management Project is the development of procedures which will offer computer support to individualizing education. The first approximation to a computer management system was incorporated in the IPI program at Oakleaf School during the 1968-69 school year. Details of the system are provided in the Center's Working Paper Series Number 44 by Cooley and Glaser. The system, under steadily increasing demands by the staff at the School and the Center, required greater flexibility and capacities than were incorporated in original design plans. Having learned much from this first system, it has been retired in favor of planning for the development of one which is more versatile.

Current plans are to develop a system which does not simply act as a receiver and dispenser of data, the role played by the first system, but rather makes more intensive use of the potential power of the computer. The computer can provide the means for significant improvements in the IPI instructional program since the computer can perform tasks which cannot realistically be carried out by the instructional staff. Our hypothesis is that the computer is the best resource available for integrating the elements of a management system for instruction. Included among these elements are:

1. collecting and storing data
2. providing input for defining student goals and monitoring individual progress toward them
3. diagnostic testing
4. providing suggested prescriptions for students based upon viable alternatives among available instructional resources
5. providing summaries of data to teachers
6. facilitating evaluation of the instructional program and curriculum development.

To implement the first five elements we intend to install a small satellite computer at the school which is capable of handling a network of terminals. Although each element of the system complements the other, it is anticipated that diagnostic testing will be a central element in the early stages of development.

Since testing occupies a sizable portion of the individual's time in IPI, more efficient test procedures could have extremely beneficial instructional results. During the 1968-69 school year, a computer-administered branched test for an 18 skill unit in IPI Mathematics was field tested. Using branching techniques and Wald's sequential decision theory for item sampling, testing time was reduced to one-half of that required by conventional paper-and-pencil tests and a more valid and reliable profile was attained.

The implementation of branched testing techniques not only has implications for instruction but for the entire computer management system. If such tests can be administered by computer a substantial percentage of data collection and processing can be eliminated by automatic record keeping. In addition, the computer can suggest work prescriptions based on test results and available instructional resources. Student goals will be set in view of the past performance records of the individual and information summarizing the performance of students who have completed the unit. The latter information will be available from a data file which is kept current to the hour.

A continuing role of the project will be to provide a year-to-date file from which data can be extracted for purposes of curriculum development and basic research. Programming support will be provided for Center staff in the interest of facilitating all research inquiry into the IPI data base.

Implementation of such a system will require the placement of computer output devices (possibly cathode ray tubes) in stations easily accessible to all teachers. Depending upon the physical arrangement of the school this could mean such a device would be placed in each classroom. In addition, a small laboratory would house four to eight such devices to serve as a base for diagnostic testing. The laboratory would also be equipped with small keyboard devices for inputting data not directly obtained by computer. The laboratory would also house other devices which along with the CRT's would be used for computer-assisted instruction.

As a student begins work on some unit, he would be assigned a computer-assisted branched test for placement within a unit. The result of such testing would be a profile indicating proficiency status on each objective of the unit. Once a unit profile is determined, the teacher may choose to interrogate the data bank to attain any available information about the child or about other children who had similar test profiles. Such data could be useful in setting appropriate short-term goals for the individual. Such goal setting permits a vigilant monitoring of pupil progress and serves as a stimulus for the student to develop his skills.

Diagnostic testing specific to single unmastered objectives within the unit will provide information needed for meaningful prescriptions. At the completion of each diagnostic test possible prescriptions for the correction of deficiencies will be suggested by the computer on the basis of available resources and in light of prior prescription action. A prescription may include programmed materials, teaching devices such as films and tapes, peer or teacher tutoring, or computer-assisted instruction. Upon completion of a test and again after mastery of a unit, all resulting data are processed and stored for future interrogation by teachers or Center staff.

As an integral part of the data management systems, descriptive reports and teacher designed displays will permit constant monitoring of the student's progress as well as provide insights into strengths and weaknesses of the curriculum.

Project Plans

Efforts to realize the long-range goals of computer-managed instruction are to be undertaken with the following objectives scheduled for completion within one year:

1. Development of a model for validating hierarchies of skills within the Mathematics curriculum.

(Objectives two through five are to be implemented in all appropriate units of Levels D and E of the Mathematics curriculum. The sample size for studies evaluating the tests will be a function of the number of students passing through the unit. An extension of the pilot study in branched testing described earlier, the information gained from this effort will greatly influence future developments.)

2. Development of hierarchies for the units for which branched tests are to be constructed.
3. Design of the logic for computer-assisted branched tests for determining unit profiles.
4. Coding of the logic for pilot runs using the University of Pittsburgh's 360/50 and a Sander's CRT or teletypewriter.
5. Experimentation using the branched tests within the framework of the curriculum.

(Objectives six through seven will be realized in the form of a pilot study of the same magnitude of the initial study on branched testing. Limited to at most two units in the Mathematics curriculum, the exact choice of units will coincide with units for which branched tests will exist. Implementation of a routine for suggesting possible prescriptions to teachers and students will be restricted to the same units.)

6. Development of diagnostic tests for objectives in one or two Mathematics units. The procedures to be followed will include:
   a. analysis of existing response data to determine error patterns and the skill deficiencies responsible for errors,
   b. analysis of content area into precisely defined domains of diagnostic categories where each category is defined by an item form and related to a specific learning activity, and
   c. development, implementation, and evaluation of a testing model for the defined purpose using the University 360/50.
7. Integration of unit placement and diagnostic testing for objectives (where such development was common to units) with a model for suggesting prescriptions based on available instructional resources. This objective includes cooperation with curriculum developers in instituting new materials and with CAI developers.

8. Planning for the eventual transfer of computer developments described in previous objectives from the Pitt Time-Sharing System to the Center's satellite computer scheduled for operation in September, 1970. Such planning will include:
    a. concern for hardware devices to be used by students and teachers, and
    b. software and language requirements to service management functions.
9. Investigation of the ability of the computer to aid in curriculum development in IPI Science. With the behavioral objectives of all of the instructional materials in Science classified as to content area and process skill, a dictionary of objectives will then be formed to facilitate their organization and utilization in the field.
10. A final objective requiring substantial effort is the provision of programming support for evaluation efforts by the Center's research staff.

The first eight objectives set for completion within a year are elements of the comprehensive plan for computer-managed instruction. Each of the activities described in the plan is developmental in nature with the emphasis on the investigation of possible techniques which utilize the power of the computer to improve the instructional process. The computer, having a far greater capacity than teachers for organizing data and using it in decision making may prove to be the most efficient tool in accommodating instruction to individuals. The implementation of the computer related activities under study will provide the opportunity to validate this position.

Outputs anticipated during the next five years include information concerning:

1. the merits and contributions of a comprehensive management system for individualized instruction,
2. the usefulness and usability of computer-assisted branched tests and diagnostic tests in IPI Mathematics,
3. the appropriateness of the models used for computer testing,
4. the feasibility of using a small computer to fulfill the needs of an extremely diversified program of computer activities,

5. appropriate hardware for maintaining a data base and for retrieving data from the same,
6. experience with the software requirements for a computer management system,
7. the acceptability of such a system to student and teacher, and
8. the potential of the system for revealing strengths and weaknesses within the curriculum.

Outputs expected during the coming year include:

1. additional data to support or contradict the implied potential of branched testing for IPI Mathematics,
2. an established procedure for determining and validating hierarchies for units in Mathematics,
3. a model for diagnostic testing of specific objectives,
4. an evaluation of the hardware used in the year's studies and recommendations for alterations, if necessary,
5. experience with the computer prescription technique,
6. a definition of needed language facilities for programming for the Center's satellite system,
7. recommendations from teachers for additions and needs in the system, and
8. answers to research questions generated by the evaluation and computer management staff at the Center.

CLARIFYING ENVIRONMENTS PROGRAM
(07)

This program is in its 10th year of a projected 20-year plan of research and development. The long-range objective of the program is to create an experimentally grounded theory of human problem solving and social interaction. Its present proximate goals are:

1. to construct new formal systems which will be of help in formulating such a general theory,
2. to design equipment and procedures in accordance with the principles of the theory, both to facilitate the testing of the merging theoretical structure, and also for the sake of educational applications,
3. to formulate heuristic principles which may help to guide empirical investigations and applications prior to the explicit formulating of the theory itself, and
4. to test parts of the theory as they are formulated.

The fundamentals of our Clarifying Environments Program are explained in three publications, the third of which contains an up-to-date bibliography for anyone who wishes to understand our program in depth (Moore, 1963; Moore & Anderson, 1968; Moore & Anderson, 1969).

Program Plans

The program will divide its efforts in 1970 between two related projects.

1. The program operates the Clarifying Environments Laboratory here at the University of Pittsburgh. This laboratory currently works with preschool children from a nearby black ghetto school. The children come to our University laboratory on a daily basis in order to learn a complex set of symbolic skills. Specifically, they are learning to read, write, type, and take dictation. The main point of their coming is to demonstrate to local and national leaders, both black and white, that children from even the most disadvantaged part of an inner city area

can reach high levels of basic intellectual skills in a relatively short period of time. This project has several sources of support, one of which is a black foundation, the Jack and Jill of America Foundation. Forty children are participating in this project and some additional ones may be brought in in 1970. In addition to its function as a demonstration, the project serves as a training center for black paraprofessionals who are learning how to run a clarifying environments laboratory. The hope is that we can be of real help in setting up a number of operating laboratories in various parts of the City of Pittsburgh.

2. A small mobile laboratory is being designed so that "prodigious" youngsters can be shown to local people in their own areas without the need to come to our central laboratory. In other words, we want to carry the university demonstration right to people's homes. The mobile unit, which should be ready early in 1970, can be thought of as an extension of the University laboratory. It is being designed so that it will be useful for purely scientific purposes as well as its demonstrational value.

ADMINISTRATIVE AND MANAGEMENT SERVICES PROGRAM

(06)

In order for the Center to achieve its stated goals, it is necessary that certain administrative and management services be provided to facilitate the research and development activities that are undertaken. This program area is a service unit for the Center's operations and the functions that are carried out by this unit permeate all the aspects of the Center's operations. The organization and operation of this unit requires a different strategy than those of the R & D programs. There are a number of aspects of the administration and management services that require continuous monitoring and evaluation. These aspects are concerned with the development of unobtrusive procedures for the collection of information on a project and program level, the development of responsive and adaptive support units, the development of a management information system for providing monitoring data for the projects and programs, and finally the development of a facilitating environment in which the Center's R & D activities can effectively function.

It is the goal of the Administrative and Management Services Program to provide the service facilities and resources that are needed to enable the Center's research and development functions to proceed with maximum efficiency and effectiveness. In order to accomplish this overall goal over the course of the next five years, four major areas will continue to be developed and expanded - management information systems, facilities, centralized services, and information services. Through the constant improvement of the function of each of these areas will it be possible to provide this Center's research and development activities with the appropriate types of support. During the course of the next year, there will be an overall attempt to continue to upgrade each of the services that the various support units are providing. The two major priority areas during this time will be the preparation of final facility specifications and plans, and implementation of a Center information service. Other areas that will be improved and expanded during this period of time are the centralized services of photography, materials production, materials duplication, audio recording, and the implementation of two card base subsystems of the management information system - personnel and equipment inventory.

Facilities Specification and Planning

As a result of the Center's expanding facility requirements and a facility construction award to the Center by the Office of Education, a great deal of effort has been placed in the development of a prototype research and development facility that will provide an appropriate environment for the effective conduct of Center activities. Although a major portion of the specifications were completed in the prior contract year, a constant assessment of the programmatic requirements of the Center and the facility will be made: Personnel studies for determining interaction patterns will be initiated, site visits to various model facilities will be held along with consultations from various product distributors. It is anticipated that during this period final architectural and engineering drawings will be completed and construction will be undertaken.

Information Services

In the second half of the previous contract year, planning was initiated to establish a Center information service that will be responsible for the distribution of the Center paper series, handling of visitors, preparation of newsletters, brochures, and general Center information. During the coming year the Information Services Office will prepare and coordinate information releases about the Center's research and development activities. One function of this unit will be that of a liaison between the Center and representatives of the various communication media (radio, newspaper, and television), both on a local and national level. Also of primary importance will be the preparation of a brochure that will provide a general description of the Center work. To supplement the brochure, a series of special reports will be initiated that will provide more detailed information about a given activity. The purpose of the brochure and special reports will be to inform the professional and lay public about the Center and the type of activities that it is undertaking.

In addition to these new activities, Information Services will continue to maintain and supervise the Center publications, provide for Center visitors, and generally handle inquiries concerning the Center activities.

Centralized Services

The centralization of Center support services will continue to be examined in terms of the appropriateness of a given service and its quality. Considerations concerning alternative procedures for obtaining the same services outside the Center or University or for determining at what point a product or item is transferred from a prototype context to one of production will be examined. Furthermore, attention will be focused as to how such services should be organized and their relationship to the R & D programs.

Specifically the material assembly, the shops, and photography and audio units of the Support Services division will be reviewed to determine their needs in terms of reorganization, staff deployment, and facility requirements. In order to provide prototype materials for both initial tryout and small scale field testing such large scale projects as the Individually Prescribed Instruction and the Primary Education Project require extensive production facilities, staff, and equipment. The production of field testing materials for settings range from three to twenty classrooms and if done over a large number of projects, would severely overload the Center's current production capacity.

Therefore, one action that will be initiated during the coming year will be to upgrade the equipment that is currently available in these units in order to increase both the rate of production as well as the quality of the production. Simultaneously, there will be an effort made to explore production facilities that reside in the local community. If such facilities can be successfully identified, efforts will be initiated to develop a coordinated production system whereby specific products involving items for field testing can be jobbed out to local organizations, thus reserving center production facilities for prototype material development.

One new central service that will be provided during the coming year will be a child-subject center. This service will permit the procurement of children, usually preschool and early elementary age, for use in testing out experimental programs within the Center, primarily those projects associated with the program areas of Basic Learning Studies and Computer-Assisted Instruction. This service will consist of providing subject transportation, handling facilities, and supervision while the children are waiting to participate in experimental studies. It is anticipated that through the initiation of this service, duplication that had occurred with previous arrangements would be eliminated in addition to reduced cost and improved efficiency.

Management and Information Systems

The Administrative and Management Services Program has continually sought to increase its efficiency in gathering and preparing management information reports. Typically, this information consists of budgetary, personnel, equipment, and space information that needs to be collected, analyzed, and appropriately displayed for the effective overall management of the Center's programs. As an initial plan of achieving this type of information system, the Center's inventory and personnel records will be placed on a card sort system for monthly processing. This information should provide the Center's management with a new level of management information concerning its operations. With the establishment and operation of these two subsystems, initial planning will be undertaken for a more extensive and complete information system involving the other two subsystems - budget and space.

The present Center budget and accounting procedures will remain in effect with the addition of an expanded project report. This addition will consist of a breakout of commitment and actual expenditures as well as a forecast of yearly project expenditures. This additional information should provide each project director with more realistic information concerning the fiscal position of his project.

Board of Visitors

(0601)

At the last annual meeting of the LRDC Board of Visitors, Dr. Burkart Holzner, the resigning Field Staff Director, suggested that the Board of Visitors become consultants to the directorate of the Center on policy making and planning and to the Center project directors on research and development. Because the Center had become a well-developed organization, it was thought that the annual reports by a Field Staff on organizational development could be discontinued. The Board, however, preferred to continue monitoring organizational developments and specifically requested a report on LRDC's relations with publishers and industry.

The Field Staff is consequently collecting data by means of interviews and document research in order to prepare this report. The report will cover the historical developments and the status of relations with publishers and industry at the present time. Attitudes, expectations, and concerns of the LRDC will be included.

A second report is in preparation for the next meeting of the Board. Individually Prescribed Instruction has become the dominant thrust and most widely recognized contribution of LRDC. Since the inception of this research and development project, LRDC has conducted a continuous evaluation. This evaluation has centered around the attainment of the innovators' goals and a comparison between the program and traditionally-taught control schools. It not only measured goal achievement but provided inputs for improving the program. Unlike incremental innovations where the consequences of a new method are more readily visible and possibly of less fundamental impact, IPI is a systems change. Because the program is now in the dissemination phase, an additional evaluative concern arises. What are the domains of IPI in the context of the range of functions of education? How clearly are the boundaries articulated for prospective users? To what extent is LRDC assuming the responsibility for identifying educational experiences not included in IPI, suggesting consequences of using IPI or proposing additional research to supplement or enrich the program? A study is being conducted to determine organizational developments relative to these questions.

It is anticipated that the above reports will be completed and presented to the Board of Visitors for the next annual meeting.

Further research is in the tentative planning stages including a study of the perceptions of faculty members of the functions of the Center and their role within the Center. The commitment, involvement, and social horizons of the Center personnel will probably be included. Although the Field Staff will continue to observe the organization, the specific areas of investigation will depend on organizational developments and the suggestions received from the Board.

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